23440-2-9149-9

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Attention: Dr. H.F. Steger

CONTRACT REPORT NO. OSQ82-00174
REG. NO. 2-9144-9

REPORT #T-12044

CONTRACT 15SQ.23440-2-1944
RECOMMENDED VALUES FOR REFERENCE URANIUM TAILINGS
(SUPPLY AND SERVICES CANADA)

March 29, 1983

DR. A.H. DEBNAM

MICROMEDIA

TECHNICAL SERVICE LABORATORIES
1301 FEWSTER DRIVE
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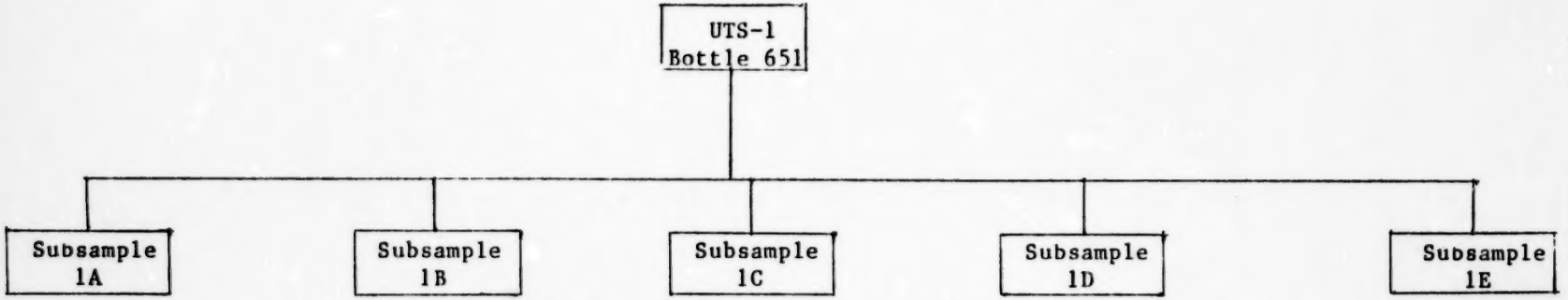
15pp

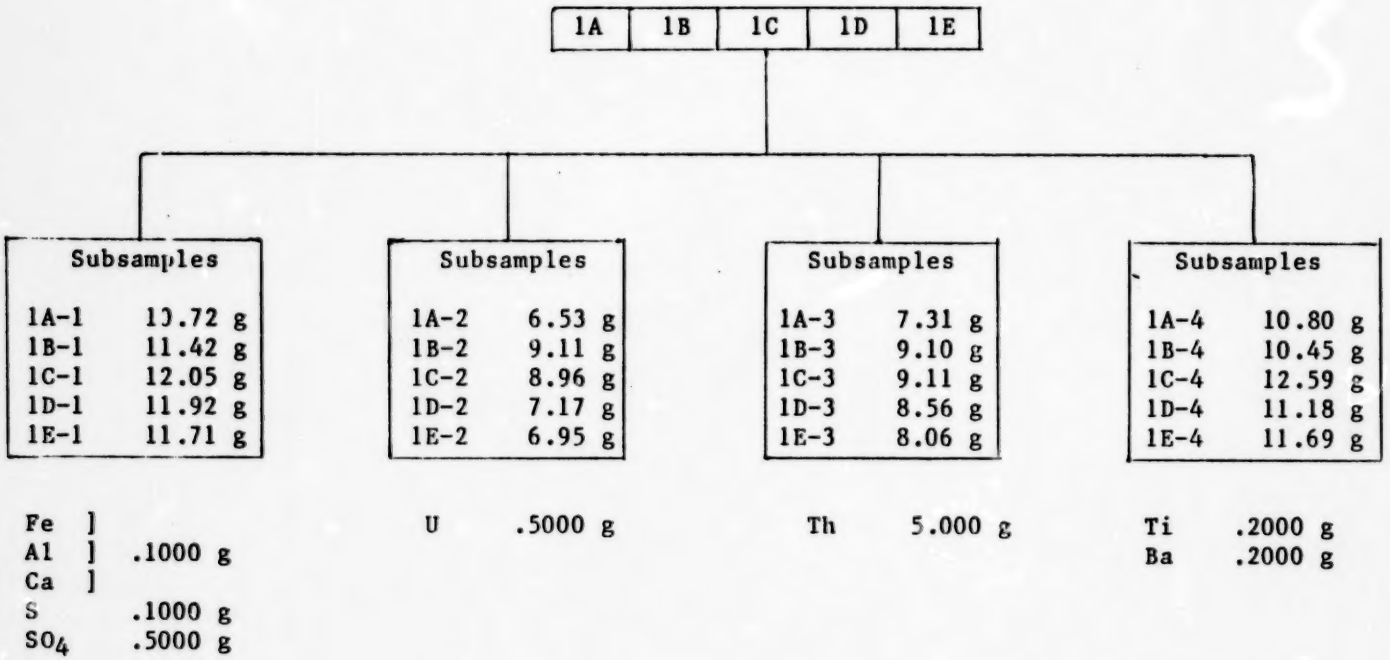
REFERENCE URANIUM TAILINGS

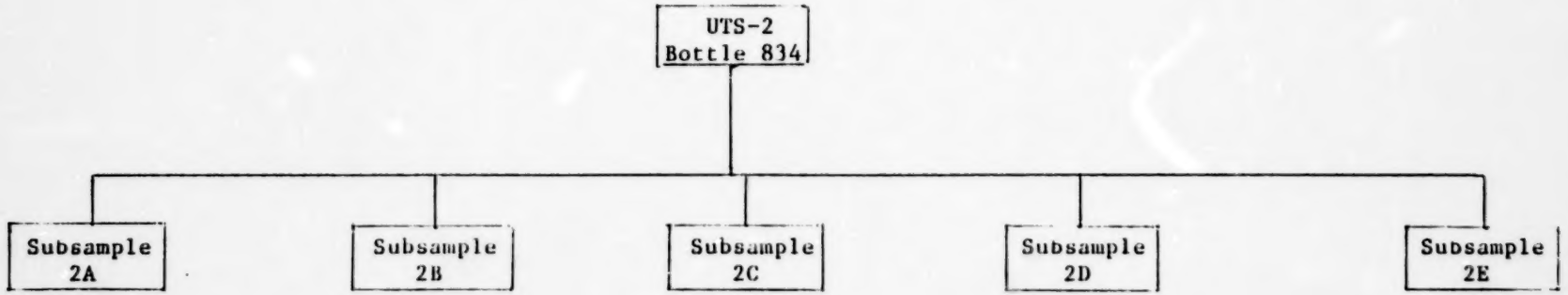
Bottle Number:

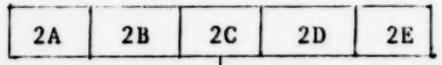
UTS-1	651
UTS-2	834
UTS-3	520
UTS-4	2

Laboratory: Technical Services Laboratories


UTS-1
Bottle 651
Subsample 1A
Subsample 1B
Subsample 1C
Subsample 1D
Subsample 1E

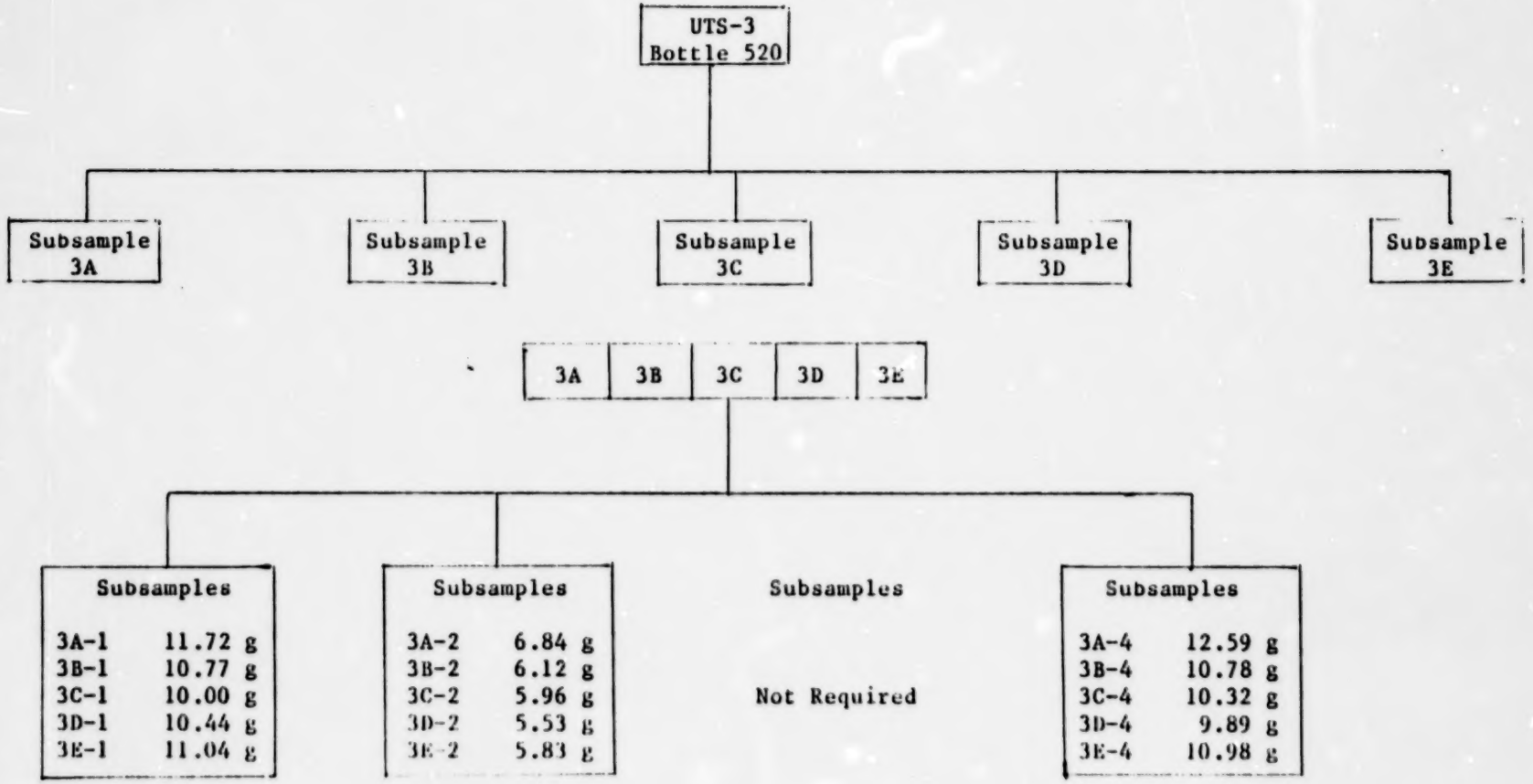

1A
1B
1C
1D
1E
Subsamples
1A-1 10.72 g
1B-1 11.42 g
1C-1 12.05 g
1D-1 11.92 g
1E-1 11.71 g
Subsamples
1A-2 6.53 g
1B-2 9.11 g
1C-2 8.96 g
1D-2 7.17 g
1E-2 6.95 g
Subsamples
1A-3 7.31 g
1B-3 9.10 g
1C-3 9.11 g
1D-3 8.56 g
1E-3 8.06 g
Subsamples
1A-4 10.80 g
1B-4 10.45 g
1C-4 12.59 g
1D-4 11.18 g
1E-4 11.69 g
Fe]
Al] .1000 g
Ca]
S .1000 g
SO4 .5000 g
U .5000 g
Th 5.000 g
Ti .2000 g
Ba .2000 g

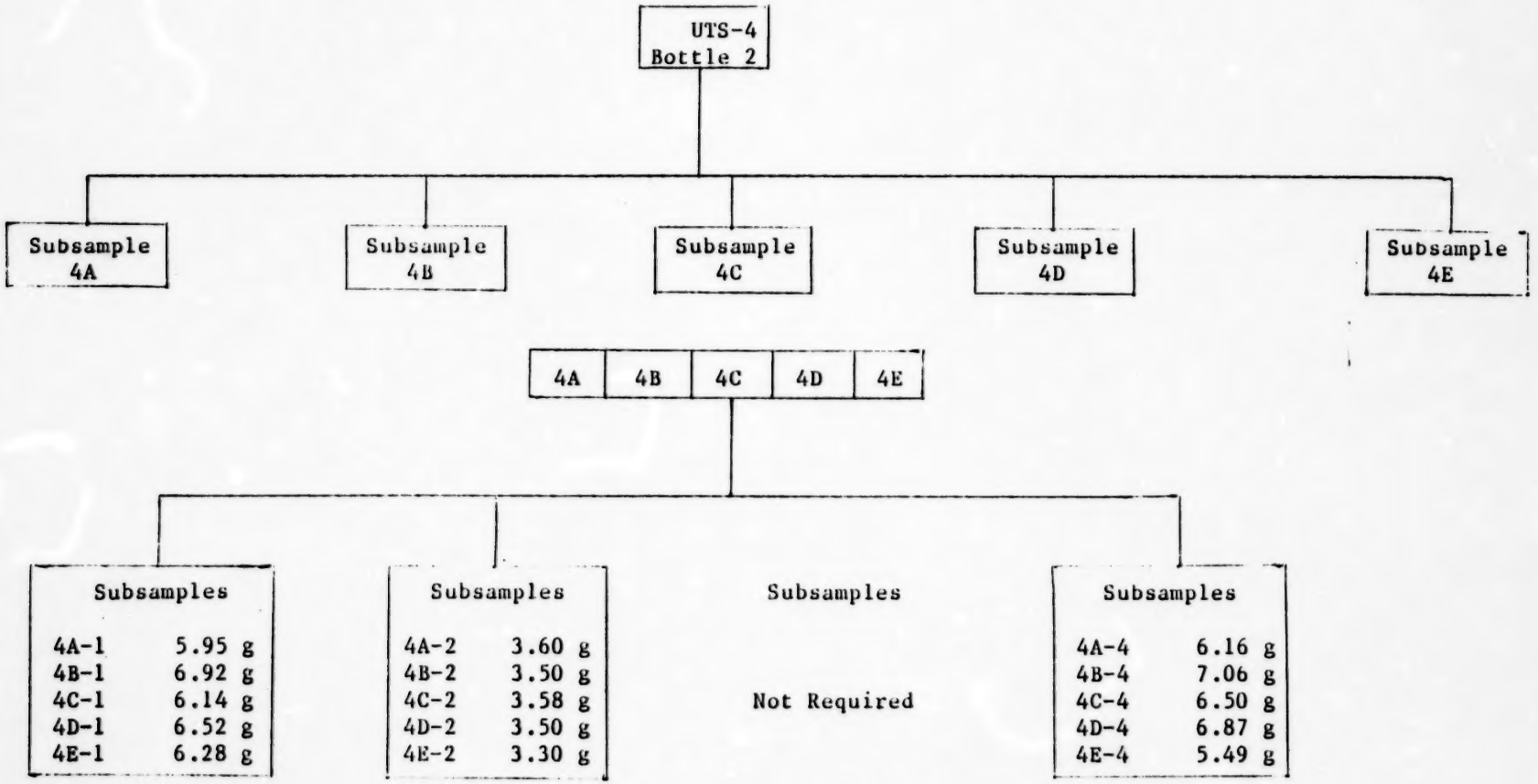




Subsamples		Subsamples		Subsamples		Subsamples	
2A-1	12.00 g	2A-2	7.04 g	2A-3	7.63 g	2A-4	11.96 g
2B-1	13.86 g	2B-2	7.00 g	2B-3	7.84 g	2B-4	14.74 g
2C-1	13.35 g	2C-2	5.75 g	2C-3	7.00 g	2C-4	12.34 g
2D-1	13.57 g	2D-2	5.77 g	2D-3	6.96 g	2D-4	13.01 g
2E-1	12.52 g	2E-2	5.30 g	2E-3	6.78 g	2E-4	12.05 g

Fe]		U	.5000 g	Th	5.000 g	Ti	.2000 g
Al]	.1000 g					Ba	.2000 g
Ca]							
S	.1000 g						
SO_4	.5000 g						


UTS-3
Bottle 520
Subsample 3A
Subsample 3B
Subsample 3C
Subsample 3D
Subsample 3E
3A
3B
3C
3D
3E
Subsamples
3A-1 11.72 g
3B-1 10.77 g
3C-1 10.00 g
3D-1 10.44 g
3E-1 11.04 g
Subsamples
3A-2 6.84 g
3B-2 6.12 g
3C-2 5.96 g
3D-2 5.53 g
3E-2 5.83 g
Subsamples
Not Required
Subsamples
3A-4 12.59 g
3B-4 10.78 g
3C-4 10.32 g
3D-4 9.89 g
3E-4 10.98 g
Fe]
Al] .1000 g
Ca]
S .1000 g
SO4 .5000 g
U .5000 g
Th not analysed
Ti .2000 g
Ba .2000 g



Fe]
Al] .1000 g
Ca]
S .1000 g
SO_4 .5000 g
Ni .1000 g

U]
Ni] .5000 g
As]

Ti .2000 g
Ba .2000 g

MAJOR ELEMENTS

Sample	Subsample	Total Iron (Fe) %	Aluminum (Al)%	Calcium (Ca) %
UTS-1	1A-1	4.85	6.32	5.27
Bottle 651	1B-1	4.87	6.34	5.36
	1C-1	4.91	6.32	5.33
	1D-1	4.94	6.31	5.30
	1E-1	4.83	6.30	5.30
UTS-2	2A-1	2.72	2.80	0.35
Bottle 834	2B-1	2.64	2.78	0.32
	2C-1	2.75	2.76	0.34
	2D-1	2.71	2.79	0.35
	2E-1	2.70	2.81	0.33
UTS-3	3A-1	3.19	5.93	3.97
Bottle 520	3B-1	3.12	5.85	3.92
	3C-1	3.18	5.88	4.01
	3D-1	3.14	5.86	3.96
	3E-1	3.15	5.90	3.95
UTS-4	4A-1	2.50	6.31	1.74
Bottle 2	4B-1	2.46	6.26	1.71
	4C-1	2.54	6.28	1.70
	4D-1	2.52	6.32	1.75
	4E-1	2.51	6.34	1.78

MAJOR ELEMENTS

Sample	Subsample	Titanium (Ti) %	Barium (Ba) %	Barium (Ba) ug/g
UTS-1 Bottle 651	1A-4	0.52	0.03	296
	1B-4	0.55	0.03	292
	1C-4	0.54	0.03	297
	1D-4	0.55	0.03	296
	1E-4	0.52	0.03	294
UTS-2 Bottle 834	2A-4	0.22	0.04	432
	2B-4	0.21	0.04	431
	2C-4	0.21	0.04	419
	2D-4	0.20	0.04	433
	2E-4	0.22	0.04	434
UTS-3 Bottle 520	3A-4	0.25	0.02	204
	3B-4	0.24	0.02	178
	3C-4	0.24	0.02	186
	3D-4	0.24	0.02	167
	3E-4	0.25	0.02	185
UTS-4 Bottle 2	4A-4	0.26	0.01	73
	4B-4	0.26	0.01	71
	4C-4	0.26	0.01	101
	4D-4	0.26	0.01	74
	4E-4	0.27	0.01	74

Sulphur - Sulphate

Sample	Subsample	Total Sulphur (S) %	Sulphate (SO_4^{2-})
UTS-1 Bottle 651	1A-1	0.98	2.56
	1B-1	1.01	2.50
	1C-1	1.00	2.47
	1D-1	1.04	2.49
	1E-1	1.00	2.51
UTS-2 Bottle 834	2A-1	3.17	0.68
	2B-1	3.26	0.70
	2C-1	3.31	0.75
	2D-1	3.29	0.71
	2E-1	3.21	0.69
UTS-3 Bottle 520	3A-1	0.27	0.07
	3B-1	0.24	0.08
	3C-1	0.24	0.06
	3D-1	0.25	0.07
	3E-1	0.27	0.06
UTS-4 Bottle 2	4A-1	1.85	5.17
	4B-1	1.84	5.10
	4C-1	1.81	5.12
	4D-1	1.80	5.15
	4E-1	1.83	5.10

Uranium - Thorium

Sample	Uranium Subsample	Uranium (U) ug/g	Thorium Subsample	Thorium (Th) ug/g
UTS-1 Bottle 651	1A-2	54	1A-3	119
	1B-2	63	1B-3	145
	1C-2	65	1C-3	122
	1D-2	59	1D-3	100
	1E-2	60	1E-3	105
UTS-2 Bottle 834	2A-2	54	2A-3	215
	2B-2	61	2B-3	161
	2C-2	59	2C-3	189
	2D-2	57	2D-3	168
	2E-2	58	2E-3	174
UTS-3 Bottle 520	3A-2	660		
	3B-2	630		
	3C-2	590		Not Analysed
	3D-2	560		
	3E-2	610		
UTS-4 Bottle 2	4A-2	1015		
	4B-2	1015		
	4C-2	1045		Not Analysed
	4D-2	1125		
	4E-2	1025		

Nickel - Arsenic

Sample	Nickel Subsample	Nickel (Ni) ug/g	Arsenic Subsample	Arsenic (As) ug/g
UTS-4 Bottle 2	4A-2	214	1A-3	40
	4B-2	200	1B-3	36
	4C-2	204	1C-3	40
	4D-2	195	1D-3	38
	4E-2	201	1E-3	38

METHODOLOGY

Iron-Aluminum-Calcium-Titanium-Barium

0.2000 g of sample was fused with lithium carbonate - boric acid flux with dissolution of the melt in HNO_3. Metal determination by ICAP emission spectrometry.

Total Sulphur

0.1000 g of sample was combusted in a Leco furnace and SO_2 determined volumetrically.

Sulphate

0.5000 g of sample was treated with HCl. SO_4 in the solution was determined gravimetrically, by precipitation of $BaSO_4$.

Uranium

0.5000 g of sample was digested in teflon with HNO_3, HCl, and HF. An aliquot of solution was extracted into ethyl acetate and the uranium determined fluorimetrically.

Thorium

Thorium was determined directly, on a 5.000 g sample in a gamma spectrometer.

Nickel

0.1000 g sample was digested in platinum with HF, HNO_3 and $HClO_4$. Final solution was in HCl. Metal determination by atomic absorption.

Arsenic

0.5000 g of sample was digested with aqua-regia ($HCl-HNO_3$). Arsenic was determined by hydride-generation and atomic absorption.

URANIUM TAILINGS UTS-1

Constituent	Sample Size (g)	Test portion									
		% 1	µg/g	% 2	µg/g	% 3	µg/g	% 4	µg/g	% 5	µg/g
Fe (total)	10.72 11.42. 12.05 11.92 11.71	4.85		4.87		4.91		4.94		4.83	
Ti	10.80 10.45 12.59 11.18 11.69	0.52		0.55		0.54		0.55		0.52	
Al	10.72 11.42 12.05 11.92 11.71	6.32		6.34		6.32		6.31		6.30	
Ca	10.72 11.42 12.05 11.92 11.71	5.27		5.36		5.33		5.30		5.30	
Ba	10.80 10.45 12.59 11.18 11.69	0.03	296	0.03	292	0.03	297	0.03	296	0.03	294
U	6.53 9.11 8.96 7.17 6.95		54		63		65		59		60
Th	7.31 9.10 9.11 8.56 8.06		119		145		122		100		105
S (total)	10.22 11.42 12.05 11.92 11.71	0.98		1.01		1.00		1.04		1.00	
SO_4^{2-}	10.72 11.42 12.05 11.92 11.71	2.56		2.50		2.47		2.49		2.51	

#1. #2.
#3. #4.
#5.

URANIUM TAILINGS UTS-2

Constituent	Sample Size (g)	Test portion									
		% 1	µg/g	% 2	µg/g	% 3	µg/g	% 4	µg/g	% 5	µg/g
Fe (total)	12.00 13.86 13.35 13.57 12.52	2.72		2.64		2.75		2.71		2.70	
Ti	11.96 14.74 12.34 13.01 12.05	0.22		0.21		0.21		0.20		0.22	
Al	12.00 13.86 13.35 13.57 12.52	2.80		2.78		2.76		2.79		2.81	
Ca	12.00 13.86 13.35 13.57 12.52	0.35		0.32		0.34		0.35		0.33	
Ba	11.96 14.74 12.34 13.01 12.05	0.04	432	0.04	431	0.04	419	0.04	433	0.04	434
U	7.04 7.00 5.75 5.77 5.30		54		61		59		57		58
Th	7.63 7.84 7.00 6.96 6.78		215		161		189		168		174
S (total)	12.00 13.86 13.35 13.57 12.52	3.17		3.26		3.31		3.29		3.21	
SO_4^{2-}	12.00 13.86 13.35 13.01 12.05	0.68		0.70		0.75		0.71		0.69	

#1 #2
#3 #4
#5

URANIUM TAILINGS UTS-3

Constituent	Sample Size (g)	Test portion									
		%	1 µg/g	%	2 µg/g	%	3 µg/g	%	4 µg/g	%	5 µg/g
Fe (total)	11.72 10.77 10.00 10.44 11.04	3.19		3.12		3.18		3.14		3.15	
Ti	12.59 10.78 10.32 9.89 10.98	0.25		0.24		0.24		0.24		0.25	
Al	11.72 10.77 10.00 10.44 11.04	5.93		5.85		5.88		5.86		5.90	
Ca	11.72 10.77 10.00 10.44 11.04	3.97		3.92		4.01		3.96		3.95	
Ba	12.59 10.78 10.32 9.89 10.98	0.02	204	0.02	178	0.02	186	0.02	167	0.02	185
U	6.84 6.12 5.96 5.53 5.83		660		630		590		560		610
Th	NA		-		-		-		-		-
S (total)	11.72 10.77 10.00 10.44 11.04	0.27		0.24		0.24		0.25		0.27	
SO_4^{2-}	11.72 10.77 10.00 10.44 11.04	0.07		0.08		0.06		0.07		0.06	

#1 #2
#3 #4
#5

URANIUM TAILINGS UTS-4

Constituent	Sample Size (g)	Test portion									
		%	1 µg/g	%	2 µg/g	%	3 µg/g	%	4 µg/g	%	5 µg/g
Fe (total)	5.59 6.92 6.14 6.52 6.28	2.50		2.46		2.54		2.52		2.51	
Ti	6.16 7.06 6.50 6.87 5.49	0.25		0.26		0.26		0.26		0.27	
Al	5.95 6.92 6.14 6.52 6.28	6.31		6.26		6.28		6.32		6.34	
Ca	5.95 6.92 6.14 6.52 6.28	1.74		1.71		1.70		1.75		1.78	
Ba	6.16 7.06 6.50 6.87 5.49	0.01	73	0.01	71	0.01	101	0.01	74	0.01	74
U	3.60 3.50 3.58 3.50 3.30		1015		1015		1045		1125		1025
Th	N.A.		-		-		-		-		-
S (total)	5.95 6.92 6.14 6.52 6.28	1.85		1.84		1.81		1.80		1.83	
SO_4^{2-}	5.95 6.92 6.14 6.52 6.28	5.17		5.10		5.12		5.15		5.10	
Ni	5.95 6.92 6.14 6.52 6.28		214		200		204		195		201
As	3.60 3.50 3.58 3.50 3.30		40		36		40		38		38

#1 #2
#3 #4
#5